VALUE IN HEALTH 19 (2016) 20–27

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/locate/jval

ORIGINAL ARTICLES
Economic Evaluation

The Cost of Increasing Physical Activity and Maintaining Weight for Midlife Sedentary African American Women

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ABSTRACT

Objective: To evaluate the marginal costs of increasing physical activity and maintaining weight for a lifestyle physical activity program targeting sedentary African American women. **Methods:** Outcomes included change in minutes of total moderate to vigorous physical activity, leisure-time moderate to vigorous physical activity and walking per week, and weight stability between baseline and maintenance at 48 weeks. Marginal cost-effectiveness ratios (MCERs) were calculated for each outcome, and 95% confidence intervals (CIs) were computed using a bootstrap method. The analysis was carried out from the societal perspective and calculated in 2013 US dollars. **Results:** For the 260 participants in the analysis, program costs were $165 ± $19, and participant costs were $164 ± $35, for a total cost of $329 ± $49. The MCER for change in walking was $1.50/min/wk (95% CI 1.28–1.87), for change in moderate to vigorous physical activity was $1.73/min/wk (95% CI 1.41–2.18), and for leisure-time moderate to vigorous physical activity was $1.94/min/wk (95% CI 1.58–2.40). The MCER for steps based on the accelerometer was $0.46 per step (95% CI 0.30-0.85) and weight stability was $412 (95% CI 399–456). **Conclusions:** The Women's Lifestyle Physical Activity Program is a relatively low-cost strategy for increasing physical activity. The marginal cost of increasing physical activity is lower than for weight stability. The participant costs related to time in the program were nearly half the total costs, suggesting that practitioners and policymakers should consider the participant cost when disseminating a lifestyle physical activity program into practice.

Keywords: African American women, economic evaluation, marginal cost-effectiveness, physical activity, weight stability.

Introduction

Physical activity is a well-established health behavior for preventing heart attacks and strokes [1]; managing hypertension [2], diabetes [3], hypercholesterolemia [4], and obesity [5]; and reducing depressive symptoms [6]. Regular physical activity is a priority for African American women who, compared with white women, have a higher prevalence of hypertension (42.9% vs. 27.7%), diabetes (14.6% vs. 6.1%), obesity (57.5% vs. 32.5%) [7], and depressive symptoms (27.4% vs 22.4%) [8]. In 2012, only 35.5% of African American women, compared with 50.9% of white women, met the 2008 physical activity guidelines for adults of engaging in at least 150 minutes of moderate or 75 minutes of vigorous aerobic physical activity per week [9]. Lower socioeconomic status among African American women, associated with poor health insurance coverage, contributes to these health disparities [10]. These findings highlight the importance of physical activity interventions to reduce risks and promote health in African American women that are not only cost-effective but also low cost to garner sustained participation.

Despite the importance of physical activity interventions to promote health in African American women, cost-effectiveness studies of physical activity interventions vary dramatically. Many of these studies are either disease-specific interventions or one-on-one primary care interventions [11–13], rather than group interventions to promote physical activity. None has focused specifically on African American women. Most evaluations of lifestyle physical activity interventions have focused on program costs [14–17]. A 2009 systematic review of the cost-effectiveness of physical activity interventions found only eight studies targeting healthy adults [17]. Only one study was conducted from the societal perspective, taking into account both the program and participant costs [17]. Participant costs, such as out-of-pocket expenditures and opportunity costs (i.e., the value of the participant's time to participate in the intervention), are rarely included in the analyses. A more complete understanding of the societal costs of these interventions, including the participant costs, is needed.

The Women's Lifestyle Physical Activity Program is a 48-week walking program for sedentary midlife African American women, which includes six group meetings with behavioral strategies.

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1098-3015$36.00 – see front matter

http://dx.doi.org/10.1016/j.jval.2015.10.009

The program has been successful in increasing physical activity. Furthermore, it has been successful in promoting weight stability [18], defined as post-treatment weight within 3% of baseline weight [19]. This is consistent with a recent review of physical activity interventions and their effect on body composition, which demonstrated that most of the women maintained their weight or lost only small amounts of weight [20,21]. The cost to improve these outcomes has not been evaluated. The program collected detailed information about the resources and costs to implement the program, as well as participants' opportunity costs of participation. The purpose of this study was to evaluate the cost-effectiveness of this program from a societal perspective, including both program and participant costs.

Methods

The 48-week Women's Lifestyle Physical Activity Program [18] was a randomized clinical trial to test the effectiveness of three intervention conditions on the adoption and maintenance of physical activity and weight stability among African American women [18]. The three intervention conditions were 1) group meetings alone, 2) group meetings supplemented by personal calls, and 3) group meetings supplemented by automated calls. The cluster-randomized, Latin-square design used in this study counterbalanced the order of administering the three conditions over six community health care sites. Each site received all three conditions, but no two sites received the conditions in the same order. The cost-effectiveness analysis was conducted from the societal perspective, including both the program and participant costs.

Participants

As described elsewhere [18,22], inclusion criteria were as follows: 1) African American female; 2) sedentary (no regular, planned moderate to vigorous physical activity [MVPA] three or more times per week in the preceding 6 months); 3) ages 40 to 65 years; 4) able to attend the group meetings; and 5) had a telephone. Exclusion criteria were as follows: 1) major signs or symptoms of pulmonary or cardiovascular disease; 2) disability preventing unassisted physical activity; 3) history of myocardial infarction or stroke; 4) blood pressure reading of 160/100 mm Hg or more [23]; and 5) in women with diabetes, a hemoglobin A_{1c} level of more than 9% [24]. Recruitment was conducted within a 2-mile radius of each of the three community health centers and three community hospitals where the study was conducted. The health care settings were all in or bordering predominantly low-income (30% below poverty level) African American (>90%) communities in Chicago [25].

Of the 609 women who responded to the invitation to participate in the program, 297 were deemed eligible [22]. Nine of the eligible women dropped out before the start of the intervention, and 28 did not complete any of the 48-week assessments, leaving 260 participants in this analysis. At baseline, the mean age of participants was 53 years (range 40–65 years) (Table 1). Our previous work has demonstrated that there is no evidence of systematic bias in the characteristics of individuals who did not complete outcomes measurement [18]. About one-third were married (38.9%). About half of the women had a college degree (49.2%). Three-fourths of the women were employed (74.2%), and 60.9% had a family income under $60,000. The vast majority of women were overweight or obese (93.9%). All women signed an informed consent form, and the study was approved by the institutional review board at two universities.

Table 1 – Participants' demographic characteristics at baseline (N = 260).

Characteristic	Value
Age (y), mean ± SD	53.5 ± 6.5
Married or living with partner, n (%)	101 (38.9)
College graduate or higher, n (%)*	128 (49.2)
Full-time or part-time employment, n (%)*	193 (74.2)
Income ($), n (%)*	
<20,000	30 (12.1)
20,000–39,999	68 (27.4)
40,000–59,999	55 (22.2)
≥60,000	97 (39.1)
Weight (kg)	205.8 ± 45.3
Body composition	
BMI (kg/m^2), mean ± SD	35.3 ± 7.5
Overweight and obesity (≥25), n (%)	244 (93.9)
Obesity (≥30), n (%)	194 (74.6)

* N = 248.

Intervention

The Women's Lifestyle Physical Activity Program has been explained in detail elsewhere [18]. Briefly, the intervention included a 24-week adoption phase and a 24-week maintenance phase. All three study conditions received six 2-hour group meetings. The first five group meetings were held on Saturdays every 5 weeks during the 24-week adoption period. One final "booster" meeting was held in the middle of the maintenance period. Groups were designed for an average of 15 participants (range 13–18). Each meeting consisted of brief individual time with a program nurse followed by a group discussion led predominately by a nurse facilitator of the same ethnicity as the participants. In a review of physical activity interventions for underserved populations, the importance of having ethnically matched study team members was emphasized as a key retention strategy [26]. Social cognitive strategies were applied systematically throughout, including behavioral capability, self-regulation, behavioral rehearsal, and vicarious experience [27]. The goal was to increase physical activity above each woman's baseline steps by a minimum of 3000 steps per day, an increase that approximates 30 minutes of physical activity [28]. Women in all three conditions were given an accelerometer/pedometer to monitor their steps and asked to enter their steps weekly into an automated telephone computer-linked system, which then generated individualized reports shared with each woman during her brief individual time at the group meetings. When using the automated system to enter their steps, participants in all three conditions could also respond to brief automated questions on health symptoms and accelerometer/pedometer problems and leave voicemails for program staff. They received a return call from a program nurse practitioner if symptoms were uncommon or urgent. If they did not enter their steps for 2 weeks, they received an automated reminder call. Women in the group-alone condition received only the intervention components described above. With the exception of reminder calls for the upcoming group meetings and reminder automated calls to report their steps in the automated telephone computer-linked system, no therapeutic contact was made with women who received the group-alone condition.

Women in the "group plus personal calls" condition received brief personal calls from their nurse group facilitator twice between each group meeting during adoption and once before and after the booster group meeting during maintenance. Motivational interviewing was used to help participants explore and resolve ambivalence about increasing their physical activity [29] and designed to address each woman's needs, experiences, barriers, motivation, and confidence [30].

Women in the "group plus automated calls" condition received automated calls that were initiated by the telephone

computer-linked system between group meetings. The content and scheduled delivery of the calls were structured to match the person-delivered calls. A total of 27 items covered topics such as ways to incorporate physical activity into daily life and benefits women could expect if they became more active.

Although all three treatment conditions demonstrated significant improvements in physical activity and weight maintenance, there were no significant differences in treatment effects between the three conditions [18]. Previous evaluation of an earlier rendition of the program demonstrated that it was effective relative to a minimal physical activity intervention (without group meetings) at improving physical activity and maintaining body composition [31]. Because there were no treatment condition effects, we pooled data across the three treatment conditions and evaluated the marginal cost-effectiveness of the Women's Lifestyle Physical Activity Program, excluding the costs of personal or automated calls from the program, by comparing baseline and 48-week outcomes for all participants.

Outcomes Measures

There were nine outcomes of interest, all computed as change between baseline and 48 weeks. These outcome measures have been described in a previous article [18] and are summarized here.

The primary outcome (change in physical activity) was measured directly with self-report and accelerometer/pedometer and indirectly by a field measure of aerobic fitness. The self-reported physical activity measures included minutes per week of MVPA using the Community Healthy Activity Model Program for Seniors (CHAMPS) physical activity questionnaire [32]. The CHAMPS asks participants to think about the previous 2 weeks and estimate the time they spent in each activity on the basis of six categories from "less than 1 hour/week" to "9 or more hours/week." We estimated minutes per week for each participant using the midpoint of each category [18]. Each activity has a metabolic equivalent (MET) value [33], and moderate physical activities were defined by MET values of 3.0 or more to less than 6 and vigorous activities by MET values of 6.0 or more. The self-reported measure included minutes per week for overall MVPA, leisure-time MVPA, and walking. For women who worked part-time or full-time within the 12 months before each assessment, occupational physical activity information was collected via the Tecumseh Occupational Activity Questionnaire [34], which included questions about self-reported time spent weekly in occupational activities, such as sitting or light work and pushing objects weighing more than 75 lb. Each of the 13 activities has an MET value, and activities with an MET value of 3 or more were summed to calculate the total number of minutes per week spent in occupational MVPA.

Each participant was given an accelerometer/pedometer to wear each day during the study (Lifecorder EX [NL2200]) [35]. We excluded days with fewer than 1200 steps recorded, based on an analysis of the distribution of steps at baseline. We determined that 1200 was the minimum number of steps taken by participants on more than 98% of the days and assumed that a day with fewer than 1200 steps represented a device malfunction or failure to wear the accelerometer/pedometer for an adequate amount of time during the day. Weeks were required to have at least 3 days of valid data to be included in the analysis. Baseline steps per day were calculated by dividing the total steps in valid days during the previous week by the total number of valid days. We used the steps in the valid days during the 4 weeks before the 48-week assessment and divided the total steps by the total number of days with valid data to calculate the mean steps per day at 48 weeks.

The 2-minute step test was used as a practical measure of aerobic fitness. This test is part of the Senior Fitness Test recommended for use in low fit older adults [36]. Participants step in place and lift their knees to a point midway between the patella and the iliac crest. The score is the number of full steps completed in 2 minutes.

Weight (pounds) was measured using a Seca Robusta 813 High Capacity Digital Scale [37] and reported to the nearest .2 lb. To obtain body mass index, standing height (inches) was measured using a stadiometer and weight (converted to kilograms) was divided by height (converted to meters) squared (wt/ht^2) [23]. Weight stability was measured by whether the participant weighed less than or equal to the baseline measure plus 3% at 48 weeks [19].

Cost Measures

The program resources used and participant opportunity costs were measured and valued as part of the randomized clinical trial. The cost analysis excluded costs that were incurred exclusively for research purposes.

The program costs included nurse facilitator time, research assistant time, nurse practitioner time, and supplies. The nurse facilitator's time was spent preparing for and facilitating group meetings and was valued at an annual salary of $68,910 (using the national mean registered nurse salary [38]). The research assistant's time was spent reviewing symptom reports, accelerometer/pedometer problems, and voicemails of health concerns left by participants in the automated telephone computer-linked system and was valued at an annual salary of $45,000. The nurse practitioner's time was spent responding to the health symptoms that participants reported on the automated telephone computer-linked system and was valued at an annual salary of $91,458. Finally, the costs of supplies, including the program manuals and accelerometers/pedometers, were included in the program cost.

The nurse facilitator's time per group meeting was estimated at 4.5 hours, which included 1.5 hours for the group meeting itself, 2.0 hours to set up before and clean up after the group meeting, and 1.0 hour to prepare for the group meeting (i.e., reviewing meeting notes and making reminder calls). The nurse facilitator's cost per meeting per participant was computed by dividing the nurse facilitator's cost per meeting by the number of participants attending each meeting. Total nurse facilitator costs per participant were calculated by summing the nurse facilitator's cost per meeting per participant for all meetings that the participant attended. For each participant, the program cost components were summed to calculate the total program costs per participant.

The participant opportunity cost included the following: 1) time using the automated telephone computer-linked system to log steps, report health symptoms and accelerometer/pedometer problems, and record voicemails for program staff; 2) time spent talking with the nurse practitioner about uncommon or urgent symptoms that they reported in the automated telephone computer-linked system; 3) group meeting attendance; and 4) travel time to and from group meetings. Travel time was estimated at 20 minutes round-trip, based on the distribution of travel distance from home address to the health center, with 70% within 3.1 miles and 90% within 9.1 miles. Participant time was converted to cost using the national mean hourly wage of $14.82 per hour in 2013 for all female workers aged 25 years and older [39]. The participant cost components were summed to calculate the total participant cost.

The program and participant costs were then summed to calculate the total cost from the societal perspective. All costs were reported in 2013 US dollars.

Table 2 – Program and participant resources used and costs (N = 260).

	Mean ± SD	
	Minutes	Total cost
Program	109.4 ± 33.5	165.38 ± 18.70
Program manual	–	6.69
Pedometer	–	98.00
Nurse leader	106.3 ± 32.6	58.69 ± 18.00
Nurse practitioner follow-up on reported symptoms	2.4 ± 5.3	1.75 ± 3.85
Research assistant review of participant voicemails	0.7 ± 1.1	0.26 ± 0.38
Participant	664.3 ± 140.9	163.96 ± 34.77
Automated telephone system	70.1 ± 38.7	17.33 ± 9.57
Initial log-in	31.0 ± 17.3	7.66 ± 4.29
Recording steps	34.7 ± 22.6	8.57 ± 5.59
Reporting pedometer problems	1.2 ± 2.3	0.30 ± 0.58
Reporting symptoms	2.5 ± 3.0	0.61 ± 0.74
Recording voicemails	0.7 ± 1.1	0.18 ± 0.26
Follow-up calls with nurse practitioner about reported uncommon and urgent symptoms	0.6 ± 1.7	0.16 ± 0.41
Group sessions	593.6 ± 123.4	146.47 ± 30.46
Total program and participant	773.7 ± 165.0	329.34 ± 49.17

Notes. Nurse leader cost per participant is equal to the nurse leader cost per group session of (149/average attendance per group session) × average number of groups attended per participant.

Data Analysis

The mean ± SD for the total cost and for the change in each of the nine outcomes for physical activity and weight stability at 48 weeks were calculated. For each outcome, we computed the marginal cost-effectiveness ratio (MCER), $\overline{\Delta C}/\overline{\Delta E}$, where $\overline{\Delta C}=\overline{C}$ is the mean program cost and $\overline{\Delta E}$ is the mean change in effectiveness or outcome at 48 weeks. To account for uncertainty in our results, we computed the 95% confidence intervals (CIs) for each MCER using nonparametric bootstrap CIs based on the 2.5th and 97.5th percentiles of 1000 bootstrapped replications [40,41]. We used the bias-corrected percentile method to account for bias in our bootstrapped CIs [41].

Finally, we computed the cost-effectiveness acceptability curve for each outcome, demonstrating the probability that the intervention was cost-effective at different threshold values for willingness to pay for additional improvements in the outcome. The cost-effectiveness acceptability curves visually present the uncertainty of our results.

Results

Average attendance per group meeting was high, with 13.7 ± 2.8 participants per meeting of the enrolled 16.0 ± 2.2. Table 2 reports the program and participant resources used and costs per participant. The mean total program time was 109 ± 34 minutes, and the mean total participant time spent in the intervention was 664 ± 141 minutes, for a total of 774 ± 165 minutes over 48 weeks. The mean program cost per participant was $165 ± $19, with 59% of these costs attributed to the accelerometer/pedometer ($98/$165). Nurse leader costs per participant were $59 ± $18. The mean participant cost was $164 ± $35, with $146 ± $30 attributed to group meeting attendance. The total cost per participant was $329 ± $49, with the participant cost representing 50% of the total ($164/$329).

Table 3 reports the mean costs, mean change in each outcome at 48 weeks, and MCERs. Occupational physical activity is reported for the 197 participants who worked in the 12 months before both baseline and 48 weeks. Accelerometer data are provided for the 178 women who had valid data at both baseline and 48 weeks. Aerobic fitness data were available for 239 women at both baseline and 48 weeks. The MCER for MVPA was $1.73/min/wk (95% CI 1.41–2.18) and for leisure-time MVPA was $1.94/min/wk (95% CI 1.58–2.40). Increasing walking time had the lowest cost per minute, with an MCER of $1.50/min/wk (95% CI 1.28–1.87). The cost to increase occupational MVPA was higher, with an MCER of $2.72/min/wk (95% CI 1.41–12.01). The cost to increase steps based on the accelerometer was $0.46 per step (95% CI 0.30-0.85), while the cost to increase aerobic fitness, as measured by steps in 2 minutes, was $43.57/step (95% CI 32.95–64.32). The MCER for weight stability was $412 (95% CI 399–456). The MCERs for women who worked were similar to the overall MCERs.

Figure 1A to H illustrates the cost-effectiveness acceptability curves for each of the eight outcomes. These figures show that between 48% and 80% of women achieved a positive change in each outcome. For the self-reported physical activity overall (Fig. 1A–D), the maximum benefit as measured by increase in physical activity would be achieved with a willingness to pay between $6 and $13/min/wk. For weight stability, 80% of the participants would have maintained or reduced weight with a willingness-to-pay threshold of $450.

Discussion

The Women's Lifestyle Physical Activity Program is a relatively low-cost group-based program at $329 per participant. Although nearly half the costs ($164) were borne by the participant, these costs were opportunity, rather than out-of-pocket, costs. Despite the opportunity costs borne by the participant, attendance was high in the program, with a mean of 5.1 of 6 group meetings completed per participant and 62% attending all six meetings. Participants were not reimbursed for their time spent attending the group meetings, and the high attendance suggests that the participants perceived the program to be "worth their time." Although these costs were not a barrier to the participants in our study, their inclusion in our calculations provides a more complete picture of societal costs associated with the Women's Lifestyle Physical Activity Program.

Most cost-effectiveness analyses of lifestyle physical activity interventions, however, have not incorporated opportunity costs into their studies and only a few have included participants' out-of-pocket costs. Elley et al. [11] quantified participants' out-of-pocket costs (e.g., exercise equipment and gym membership costs, travel to exercise sessions), but did not include participants' opportunity costs associated with the intervention. Similarly, Golsteijn et al. [42] included participants' out-of-pocket costs (e.g., gym membership fees, travel to health care provide visits), but again did not include participants' opportunity costs. Because of the structure of their interventions that required a very small amount of the participant's time, participants' opportunity costs in both studies were likely small. Elley et al.'s [11] intervention included 10 minutes of brief advice and an exercise prescription by a nurse, with five follow-up support telephone calls. The intervention by Golsteijn et al. [42] involved participants reading physical activity advice via print materials or the Web. In the present study, we did not measure lost job productivity such as absenteeism and presenteeism. The productivity

Table 3 – Costs, change in outcomes, and marginal cost-effectiveness ratios at 48 wk.

Change in outcome at 48 wk	N	Mean ± SD		
		Cost ($)	Change in outcome ± SD or n (%)	MCER (95% CI)
CHAMPS (min/wk)				
Change in MVPA	260	329 ± 49	190 ± 366	$1.73 (1.41–2.18)
Change in leisure-time MVPA	260	329 ± 49	170 ± 312	$1.94 (1.58–2.40)
Change in walking	260	329 ± 49	219 ± 342	$1.50 (1.28–1.87)
Occupational activity (min/wk)				
Change in occupational MVPA	197	330 ± 47	121 ± 735	$2.72 (1.41–12.01)
Change in occupational walking	197	330 ± 47	47 ± 670	$7.02 (–8.60 to 189.34)
Accelerometer, steps	178	339 ± 38	739 ± 2570	$0.46 (0.30–0.85)
Aerobic fitness (steps in 2 min), steps	239	331 ± 48	7.6 ± 18.7	$43.57 (32.95–64.32)
Weight stability	260	329 ± 49	208 (80.0)	$412 (399–456)
Participants with part-time or full-time work only				
CHAMPS (min/wk)				
Change in MVPA	197	330 ± 47	184 ± 335	$1.79 (1.42–2.33)
Change in leisure-time MVPA	197	330 ± 47	169 ± 296	$1.95 (1.57–2.51)
Change in walking	197	330 ± 47	210 ± 327	$1.57 (1.31–2.00)

CHAMPS, Community Healthy Activity Model Program for Seniors; CI, confidence interval; MCER, marginal cost-effectiveness ratio; MVPA, moderate to vigorous physical activity.

loss for our cohort of women was expected to be relatively small, however, given that the participants were sedentary but otherwise healthy individuals and 26% were not working.

These results demonstrate that it is relatively inexpensive to increase steps, at a one-time cost of $0.46 per step per day. In addition, we found that the cost to increase walking was low, at a one-time cost of $1.50 for each additional minute per week. This translates into a total cost of $225 or $4.33 per week over the course of a year to increase walking by 150 minutes per week. Not surprisingly, the societal cost to increase MVPA was more expensive at $1.73 for each additional minute per week, or $4.99 per week for 1 year to increase weekly MVPA by 150 minutes. More than three-quarter of the participants maintained or lost weight, translating into a per-person cost of $412 or $7.92 per week for 1 year for weight maintenance.

The cost to increase leisure-time physical activity was substantially less than the cost to increase physical activity during work. Among those who were employed, the cost to increase leisure-time MVPA was $1.79 for each additional minute per week, while it cost $2.72 for each additional minute per week at work. Similarly, the cost to increase leisure-time walking was $1.57 while it cost $7.02 for walking at work.

The cost per additional minute of physical activity per week in the Women's Lifestyle Physical Activity Program is relatively low, compared with that in other lifestyle physical activity interventions with economic evaluations. In Elley et al.'s [11] physical activity intervention for less-active women that included an exercise prescription, brief primary care nurse advice, and telephone and face-to-face follow-up, they found an incremental cost-effectiveness ratio of $2.82 (in 2008 NZ dollars; $5.26 in 2013 US dollars) per minute per week of physical activity sustained to 12 months for their intervention relative to usual care from a general practitioner, compared to $1.73/min/wk in our study. Although Elley et al.'s cost estimate included health care costs, the total difference in costs between groups was roughly half the total cost of our program. In the study by Sevick et al. [14] of different modes of delivering tailored, individualized feedback to increase physical activity, they found an incremental cost-effectiveness ratio of $3.53 (in 2004 US dollars; $4.35 in 2013 US dollars) per month per minute of improvement in physical activity for the print-based intervention (the equivalent of $530 per month to increase physical activity from 0 to 150 minutes) and $0.35 per month per minute for the Web-based intervention (the equivalent of $53 per month to increase physical activity from 0 to 150 minutes) compared with individuals in the control group who did not receive the individualized feedback. To increase physical activity from 0 to 150 minutes per week with our program, the one-time cost would be $259.50 or $21.63 per month, less than half the cost of Sevick et al.'s program. Taken together, these results suggest that the Women's Lifestyle Physical Activity Program is a low-cost program for increasing physical activity for sedentary women, even after considering participant opportunity costs.

Strengths of our study include the use of objective measures of physical activity via an accelerometer/pedometer worn throughout the 48-week study period in addition to self-reported physical activity measures and an objective measure of health via weight. To our knowledge, this was the only study out of nine cost-effectiveness analyses of lifestyle physical activity interventions that included physical activity measurement through an accelerometer/pedometer [11–14,16,42–44]. In addition, we collected actual resource use for almost all cost components. Those that were estimated by program staff represented a relatively small proportion of the overall costs. In particular, our inclusion of the actual time participants spent in the intervention group meetings was unique, given that inclusion of any participant costs was rare in previous cost-effectiveness analyses of lifestyle physical activity programs. Future studies of the cost and cost-effectiveness of lifestyle physical activity programs should explicitly include and report the participant cost, because it represents a substantial portion of the societal cost.

This study has several limitations that should be considered when interpreting the results. One limitation is that the program impact was based on nonexperimental analyses. Although the Women's Lifestyle Physical Activity Program was an experimental design, there were no significant differences in outcomes across the three intervention groups. Our cost-effectiveness analysis, therefore, was a comparison of the preintervention versus postintervention physical activity and weight. The Women's Lifestyle Physical Activity Program included several key components—social support via group meetings, accelerometer/pedometer use to track and provide real-time feedback on physical activity, and goal setting and reporting. We were unable, however, to determine which of these components were most

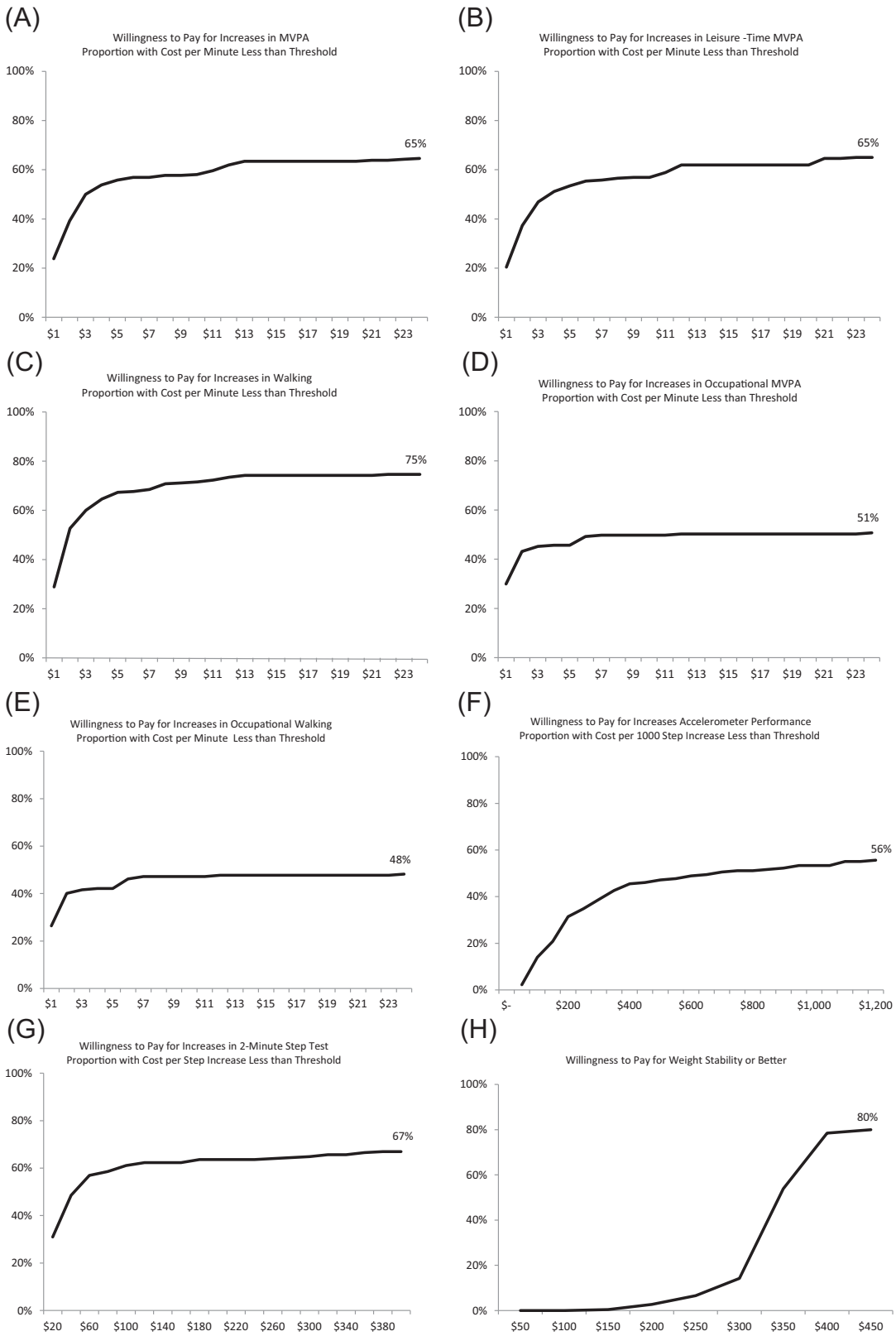

Fig. 1. – Cost-Effectiveness Acceptability Curves for Changes in Physical Activity and Weight Stability.

important in increasing physical activity. A systematic review of pedometer use demonstrated that pedometers, in conjunction with a step goal and step diary, are effective at increasing physical activity [45]. Future work should quantify the incremental impact of the program components relative to effective pedometer use alone. In addition, the sample was made up

entirely of urban African American women and may not generalize to other groups.

With the passing of the Affordable Care Act, employers can offer incentives of up to 30% of health insurance premiums for participation in wellness programs [46]. With this added incentive for wellness, employers are searching for physical activity programs that cost-effectively improve physical activity and health and ultimately reduce health care expenditures. Group lifestyle physical activity interventions are well-suited as workplace-delivered programs because the workplace has a built-in social support network, the format is efficient to deliver to multiple individuals at one time, and the opportunity cost for participants is reduced because the intervention is at work; however, rigorous evidence of the cost-effectiveness is critical for adoption.

Our results demonstrate that the Women's Lifestyle Physical Activity Program is a relatively low-cost group meeting intervention to increase physical activity. There is no standard, however, for how much policymakers are willing to pay per additional minute of physical activity, for engagement of at least 150 minutes of MVPA per week, or for weight maintenance or loss. To overcome the lack of an established threshold for cost per improvement in physical activity, we have reported the proportion of individuals achieving an improvement in outcomes at a range of costs, and these results can inform practitioner and policymaker decisions about the investment needed to improve physical activity and body composition. Future work should evaluate the cost savings associated with downstream improvements in health outcomes in this population because these potential cost savings would be important data for practice and policy decisions.

Source of financial support: This research was supported by a grant from the National Institute of Nursing Research (grant no. R01NR004134).

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